JFAS Journal of Food and Agriculture Science for Lowland & Coastal Area

ISSN 3047-8200
Original Scientific Paper
https://jfas.upnjatim.ac.id/index.php/jfas/index

REGULAR ARTICLE

APPLICATION OF TRICHODERMA BIOFERTILIZER ON TERUNG UNGU PLANT (*Solanum melongena* L.) IN FARMER GROUP SUMBER MAKMUR RUSUN WARUGUNUNG

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ABSTRACT
Trichoderma sp. as a biological agent is known to improve soil fertility and plant disease resistance. The research method used a field experiment design with several dose treatments of Trichoderma biofertilizer. This study aims to evaluate the effect of Trichoderma biofertilizer on the growth and yield of purple eggplant (*Solanum melongena* L.) in Sumber Makmur Farmer Group, Warugunung Flat. The results showed that *Trichoderma* sp. application significantly increased plant height, fruit number, and fruit weight compared to the control (without biofertilizer). This increase was thought to be due to Trichoderma's ability to improve soil structure and increase nutrient availability. Thus, the use of Trichoderma biofertilizer can be recommended as an alternative to chemical fertilizers for more sustainable and environmentally friendly purple eggplant cultivation.

Keywords: Hayati, Trichoderma, Terung, Pangan

INTRODUCTION

Fertilization is one of the efforts that can be taken in maximizing crop yields. Fertilization is done as an effort to meet the nutrient needs of plants so that production goals can be achieved **(Naiborhu et al., 2021).** Unwise or excessive use of fertilizers can cause problems for cultivated plants, such as poisoning, susceptibility to pests and diseases, low production quality and in addition, high production costs and can cause pollution. Fertilizers are materials that are added to the soil or plant canopy with the aim of supplementing nutrient availability. The earliest fertilizer materials used were animal manure, weathered plant residues, and wood charcoal **(Putra et al., 2021)**. The types of organic fertilizers that are widely known include manure, compost, guano fertilizer, and humus. These fertilizers are all made from organic materials made from different bases **(Dewi and Afrida, 2022)**. Organic fertilizers in the form of solid or liquid can be enriched with minerals or microbes that are useful for increasing the content of nutrients and soil organic matter, as well as improving the physical, chemical, and biological properties of the soil **(Agustini and Riyanti, 2020)**. Research and application of *Trichoderma* sp. as a biological agent has great potential to support agricultural sustainability and efficiency **(Thya, 2023)**. One of the efforts that can be done is by applying manure and *Trichoderma* sp.

Trichoderma sp. is a genus of fungi that provides great prospects for the implementation of environmentally friendly agriculture, especially the effect of its activities as a provider of nutrients for plants and an agent that supports plant growth. Trichoderma is a fungus that can be used as a biological control in addition to having the ability as a biofertilization agent for plants. In addition to producing antimetabolite compounds that can inhibit pathogens, this fungus is also able to degrade organic matter that produces nutrients for plants **(Li et al., 2019; Sutarman, 2019)**. Based on the potential possessed by *Trichoderma* sp, it is also expected to reduce dependence and overcome the negative impact of the use of synthetic pesticides that have been used to control plant diseases **(Zamriyetti and Rambe, 2002; Rizal and Susanti, 2018)**.

Its utilization as a biofertilizer biological agent can increase the efficiency of plant cultivation while reducing the use of synthetic chemical fertilizers and pesticides that are not environmentally friendly.

Therefore, it is necessary to study and deepen knowledge to determine the growth response of purple eggplant plants to Trichoderma biofertilizer which will be carried out at the Sumber Makmur Farmer Group. The Sumber Makmur Farmer Group located in Warugunung Flat Block Manyar B RT.4 / RW.3 Surabaya is a farmer group engaged in hydroponic and conventional-based horticultural crops which are mostly dominated by housewives aged between 40-50 years.

MATERIAL AND METHODS

Time, Place and Implementation

This research was conducted from October 2023 to December 2023. The place of implementation of the Professional Work Lecture (KKP) is located at the Sumber Makmur Farmer Group, Warugunung, Karang Pilang District, Surabaya City, East Java. Cultivation of purple eggplant plants is carried out on conventional land owned by the Sumber Makmur farmer group to determine the effect of applying Trichoderma biofertilizer on the growth of purple eggplant plants. This cultivation activity is planting purple eggplant on three beds measuring 1×4 m and by giving different treatments on each bed. There are three treatments given, namely the treatment of Trichoderma biofertilizer (P1), the treatment of manure (P2), and the control treatment (P3). The number of purple eggplant plants planted was 15 plants on each bed which were arranged into two rows with a spacing of 50×50 cm (figure 1).

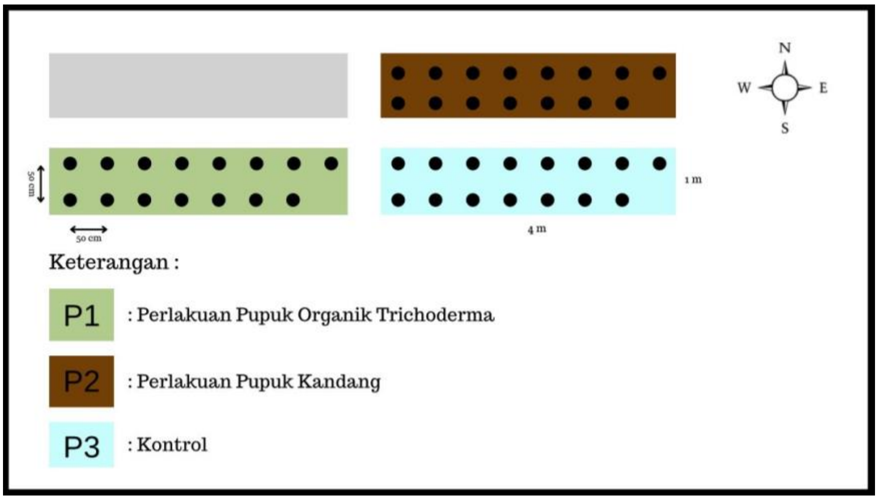

Figure 1. Research Area

Preparation of *Trichoderma* sp.

The required materials consist of Trichoderma sp. isolate, 0.5 kg of rice and 50 g of bran or rice bran. The manufacturing process starts with washing the rice using water until it is clean, then putting it into a 1.5 L bottle and adding water in a 1:1 ratio and soaking for one night. The next process is to put the bran into the bottle containing rice, then stir until the rice and bran are well mixed, then remove the water in the bottle until it runs out completely. The next process is to put the rice and bran mixture in plastic as much as 2 tablespoons, then tie the plastic tightly and do the same process until the media runs out. The next step is to steam the rice and bran mixture that has been put into the plastic using a steaming pot for ± 30 minutes. After the steaming process is complete, the media is removed from the pot and left until the media cools down, because if it is still hot then the inoculation process of Trichoderma sp. The next step is to inoculate or insert *Trichoderma* sp. into the media in the plastic using an ose needle, the parent (biang) is inserted in sufficient quantities and then the plastic is immediately folded and stapled to prevent contamination. Furthermore, the media is stored in a place that is not exposed to sunlight, and observe until the fungus grows.

Data Analysis

Growth data were obtained through laboratory analyzed soil samples. The data obtained were then tabulated and continued with the analysis of variance (ANOVA) test. If the treatment is significant, the 5% BNJ test is continued to determine the effect of differences between treatments.

RESULTS AND DISCUSSION

Soil Conditions and Location Climate

The soil type in the area of the Sumber Makmur Farmer Group in Warugunung Flat, Karang Pilang is classified as vertisol soil type. Vertisol is one type of soil that generally has hard or dense physical properties when dry so that it is difficult to use during the dry season. According to **Farid (2022)** vertisol soil types are gray-black, clay textured, have fracture scratches and fractures that can open and close, low infiltration speed and slow drainage. The average temperature in the conventional cultivation field of the Sumber Makmur Farmer Group of Warugunung Flats ranges from 24-37ºC. According to **Rahmanto et al. (2022)** Climate type classification is used to group an area into the same type of climate type. One of the commonly used climate classifications is the Schmidt-Ferguson climate classification. Schmidt-Ferguson uses the ratio (Q) between the average number of dry months ($(\overline{CH})bk$) and the average number of wet months ($(\overline{CH})bk$). The results of the comparison are grouped into 8 types of the same climate type.

Table 1. Rainfall Data in Karang Pilang Sub-District, Surabaya City

Bulan / Tahun	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September	Oktober	November	Desember	Total	Q
2013	648,7	197,3	430,3	141,1	179,4	234,6	90,5	3	0	5,6	80,2	371,1		
2014	301,7	266	342	247,9	50,9	68,8	5,8	5,1	0	7,9	68,3	377,2		
2015	503,4	339,1	282,6	168,6	96,1	0,2	0	0	0	0	167,9	137,6		
2016	288,8	427	154,3	181,8	287,5	77	76,7	55,5	82,5	170,4	190,1	384,1		
2017	463,7	244,8	221,7	157,7	185,7	119,5	24,6	0	9,5	57	319,1	276,7		
2018	190,8	222,5	205,8	44	4,1	25,5	0	45,2	0	0	147,8	214,1		
2019	397,3	316,5	183,5	290,2	18,2	0	1,7	0	0	0	16,8	72,8		
2020	182,7	481,1	384,8	436	96,2	29,6	14,7	23,1	0	68,2	268,1	532,9		
2021	349,4	599,3	392,8	82,5	75,3	64,2	1,5	2,3	60,3	10,8	233,4	481,1		
2022	264,7	426,9	360,3	98,6	103,6	98,2	12,4	1,3	0,6	289,4	423,3	190,1		
BK	0	0	0	1	3	4	8	10	8	7	1	0	42	0,688525
BB	10	10	10	7	4	2	0	0	0	2	7	9	61	

How to determine the Schmidth-Fergusson climate type using the Q comparison price which is defined as follows:

$$Q = \frac{Average\ number\ of\ dry\ months}{Average\ number\ of\ wet\ months}$$

Dry Month (BK) is if an area in one month has a total rainfall < 60 mm. Humid Month (BL) is if an area in one month has a total rainfall of 60 - 100 mm. Wet Month (BB) is if an area in one month has a total rainfall of >100 mm.

Table 2. Schmidt-Ferguson Climate Classification

Tipe Iklim	Keterangan	Vegetasi	Kriteria (%)
A	Sangat Basah	Hutan Hujan Tropika	0 < Q < 14,3
B	Basah	Hutan Hujan Tropika	14,3 < Q < 33,3
C	Agak Basah	Hutan Rimba	33,3 < Q < 60,0
D	Sedang	Hutan Musim	60 < Q < 100
E	Agak Kering	Hutan Sabana	100 < Q < 167
F	Kering	Hutan Sabana	167 < Q < 300
G	Sangat Kering	Padang Ilalang	300 < Q < 700
H	Kering Ekstrim	Padang Ilalang	700 < Q

The climatic conditions in Karang Pilang Subdistrict, Surabaya City are obtained when looking at table 2 of the Schmidt-Ferguson Climate classification, namely::

$$Q = \frac{42}{61} = 0{,}689 = 68{,}9\%\ (Tipe\ Iklim\ D)$$

Climate type D classification with Moderate category and classified in areas with seasonal forest vegetation of 6%. Climate type D has slightly more wet months than dry months, making climate type D suitable for purple eggplant plants.

Growth Observation Results

Organic fertilizers are able to increase soil chemical fertility, increase soil biological fertility, and affect soil physical properties by stimulating granulation and increasing the supply and availability of nutrients such as N, P, and K. Organic fertilizers can be solid or liquid. According to **Septirosya et al., (2019)** liquid organic fertilizer is a fertilizer that can provide nutrients according to the needs of plants because of its liquid form, if there is excess fertilizer capacity in the soil, plants will easily regulate the absorption of the required fertilizer composition. Trichoderma sp. is a fungus that can be a biocontrol agent because it is antagonistic to other fungi. Apart from being a biological agent against plant diseases, Trichoderma sp. can also increase the growth and development of the plants it infects. Trichoderma sp. functions as a decomposer of organic matter, while increasing plant productivity, and controlling soil-borne disease pests. This is in accordance with the statement of **Doo et al. (2023)** that the availability of nutrients from organic matter that has been decomposed by microbes, as well as suitable environmental conditions for Trichoderma sp. causes Trichoderma sp. able to compete with soil pathogens for nutrients. The content of nutrients in the form of nitrogen (N) and phosphorus (P) produced by the activity of Trichoderma sp. was able to increase plant growth.

Table 3. Application of Trichoderma as Part of Biofertilizer

Diaplikasikan bersama dengan	Tanaman	Jenis *Trichoderma*	Hasil penelitian	Referensi
Pupuk organik (kotoran ayam, kotoran sapi, dan cair kompleks)	Kentang (*Solanum tuberosum* L.)	*Trichoderma sp.*	Tinggi tanaman, jumlah bunga, luas daun dan jumlah cabang pertanaman mengalami peningkatan dari umur 4, 6, 8, dan 10 minggu setelah tanam (MST)	Lehar, 2012
Pupuk Hayati	Terung Ungu (*Solanum molongena* L.)	*Trichoderma harzianum*	Jumlah bunga, jumlah buah, bobot buah, panjang buah, dan bobot kering meningkat	Utama et al., 2015
PGPR (*plant growth promoting rhizobacteria*)	Tanaman cabe (*Capsicum annum*)	*Trichoderma viride*	Jumlah percabangan, jumlah buah, dan hasil buah tertinggi.	Singh & Sharma, 2019

Source: Doo et al., (2023)

Propagation of Trichoderma sp. was carried out using a mixture of rice and bran. Propagation can be done using artificial media containing nutrients for the growth of Trichoderma sp. The results of research by **Novianti (2018),** bran, rice, sawdust and rice husks can be used as a medium for propagating Trichoderma sp. These materials contain carbohydrates, fiber, nitrogen, phosphate, potassium, which are needed for the growth and development of Trichoderma sp. **Novianti (2018)** also stated that Trichoderma sp. cultured on bran media produced the best growth and conidia density compared to corn, rice, and sawdust media. The manure used was a mixture of cow manure and goat manure. According to **Faiz et al., (2021)** goat manure contains higher N and K than cow manure and P elements equivalent to other manures. Cow manure has advantages in higher fiber content such as cellulose, cow manure can provide benefits to plants, namely providing macro and micro nutrients for plants.

The fertilization treatment was given after the plants were one week after planting (MST) in accordance with the treatment beds that had been determined, namely the first bed for Trichoderma biofertilizer treatment (P1) at a dose of 200 ml per plant, the second bed for manure treatment (P2) at a dose of 20 gr per plant, and the third bed for the control treatment (P3). Trichoderma fertilizer was applied by making a hole near the purple eggplant plants, then Trichoderma fertilizer was poured into the hole. The application of manure was done by burying it in the soil around the purple eggplant plants. Observation of eggplant plants was carried out nondestructively with an observation time interval of one week. Observations were made for five weeks. Parameters observed included plant height and number of leaves. Measurement of plant height is done manually with a ruler, measured from the growing point to the tip of the leaf or the tallest leaf. The calculation of the number of leaves on purple eggplant plants is done manually by directly counting the number of leaves that have opened completely..

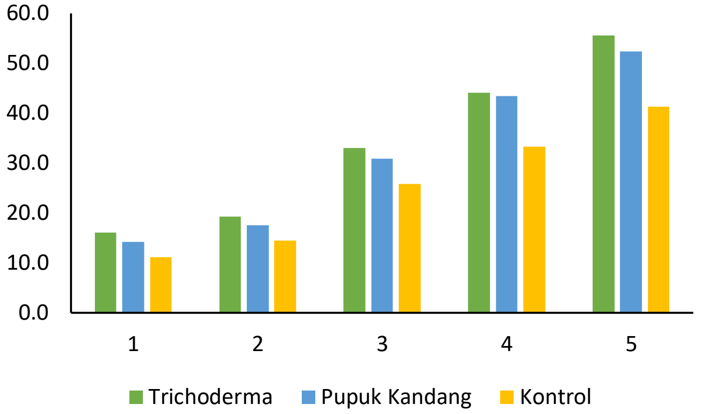

Figure 2. Grafik Rata-rata Hasil Pengukuran Tinggi Tanaman Terung Ungu

The average plant height of purple eggplant treatments 1, 2, and 3 during the five weeks of observation were 33.6 cm, 31.7 cm, and 25.2 cm, respectively. Based on the graph of average plant height (Figure 2) in the last week of observation, it shows the highest average plant height is in the Trichoderma treatment. Trichoderma treatment (P1) produced the highest average plant height, although it was not significantly different and was still considered the same as the other treatments. This is thought to be because the fungus Trichoderma sp. helps in the decomposition process so as to accelerate the decomposition of nutrients contained in the soil. Some of the roles of Trichoderma sp. in nature are as biological agents, decomposing organic matter, and increasing plant growth. According to **Ramdhan et al. (2022)** *Trichoderma* sp. fungi act as decomposers in the composting process to break down organic matter such as cellulose into glucose compounds. Another advantage of Trichoderma sp. is that it can be used as an environmentally friendly bio fungicide **(Ramdhan et al., 2022).**

Based on the results of calculations using two-factor ANOVA, data on plant height observations at the age of 1, 2, 3, 4, 5 weeks after planting, it can be seen that the average plant height is not significantly different and is still considered the same. This can be seen from the p-value > alpha (0.05). The data showed that the application of Trichoderma fertilizer did not significantly affect the parameters of plant height. This is thought to be due to the use of one of the materials for making Trichoderma fertilizer using tap water (PDAM), where this tap water contains chlorine in the form of chlorine which can kill Trichoderma fungi. It is also suspected that the available nutrients have not been fully absorbed by the plants, the occurrence of high rain intensity at the time of the study caused the leaching of nutrients on the research site. In addition, the response of plants to organic fertilizers is slower, because organic fertilizers are slow release. The application of organic fertilizer requires a decomposition process first because organic fertilizer is slow release (releasing nutrients slowly so that the release of nutrients occurs little by little), this means that the nutrient content in the soil applied with organic fertilizer is still there and can be used for the next planting without adding more fertilizer (**Noahfarel, 2022).**

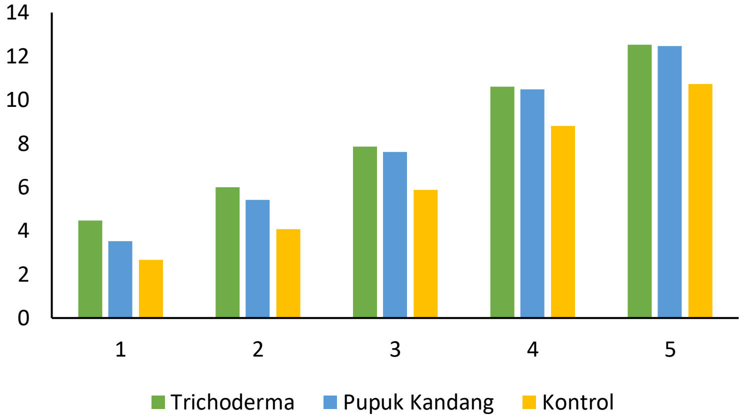

Figure 3. Rata-rata Hasil Perhitungan Jumlah Daun Tanaman Terung Ungu

The average number of leaves of purple eggplant plants in treatments 1, 2, and 3 during the five weeks of observation was 8.4; 7.6 and 6.6, respectively. Based on the graph of the average number of leaves (Figure 3) in the last week of observation, the highest average number of leaves was in the Trichoderma treatment.

Trichoderma treatment (P1) produced the highest average number of leaves, although it was not significantly different and was still considered the same as the other treatments. This is probably because the addition of Trichoderma fertilizer can increase the elements available to plants. Trichoderma fertilizer can increase the elements available to plants. Trichoderma fertilizer that has been given is able to decompose some of the nutrients needed by plants and is able to suppress the attack of soil-borne pathogenic fungi that can interfere with the growth of purple eggplant. This is in accordance with the statement of **Harni et al. (2017)** that Trichoderma is able to produce secondary metabolites that can be used to inhibit or kill pathogenic fungi or bacteria. Secondary metabolites produced by Trichoderma can function in plant resistance to plant pathogens.

Based on the results of calculations using two-factor ANOVA, observation data on the number of leaves at the age of 1, 2, 3, 4, and 5 weeks after planting, it can be seen that the average number of leaves is not significantly different and is still considered the same. This can be seen from the P-value > alpha (0.05). This is thought to be due to the use of one of the materials for making Trichoderma fertilizer using tap water (PDAM), where this tap water contains chlorine in the form of chlorine which can kill Trichoderma fungi. Decomposition of nutrients by Trichoderma helps the availability of nutrients for plant growth. One of the nutrients resulting from decomposition is nitrogen. According to **Ramdhan et al. (2021)** nitrogen spurs leaves that act as indicators of plant growth in the photosynthesis process. The even distribution of light that can be received by the leaves causes an increase in the assimilation process that occurs so that the accumulated assimilation results will be more, where the assimilate will be used as energy for plant growth to form vegetative organs such as leaves and plant height.

Based on these results, Trichoderma fertilizer gives a better effect than manure, although it only has a slight average difference. This is thought to be due to the form of manure in the form of solids and Trichoderma fertilizer in the form of liquid, where manure will be absorbed longer than Trichoderma fertilizer in the form of liquid. According to **Wuli et al. (2021),** the response of plants to organic fertilizers is slower because organic fertilizers are slow release or the process of decomposing nutrients is slow, and the content of nutrients in organic fertilizers is difficult to predict, so that the nutrients contained in the soil media have not been optimally absorbed by plants.

CONCLUSION

The effect of the treatment of Trichoderma biofertilizer, manure, and control on the growth of purple eggplant plants showed results that were not significantly different or still considered the same. Trichoderma biofertilizer gives the best effect on the growth of plant height and number of leaves of purple eggplant because Trichoderma helps in the decomposition process so as to accelerate the decomposition of nutrients contained in the soil and increase plant growth. Thus, the use of Trichoderma biofertilizer can be recommended as an alternative to chemical fertilizers for more sustainable and environmentally friendly purple eggplant cultivation.

ACKNOWLEDGMENTS

The results of this study are expected to provide useful information for farmers and developers of purple eggplant plants in Indonesia. We hope that this research can help increase the productivity of purple eggplant plants and improve the quality of the results. Thank you to the Sumber Makmur Farmer Group of Warugunung Flat for giving us the opportunity to conduct this research. We also thank all those who have helped in the implementation of this research.

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